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Appendix 3

Application 09/376381

In most situations of practical relevance, there are certain characteristics which are similar with all type of options, such as the call price and the stock price will change in the same direction, which must exist. This is fundamental otherwise the option is not an option.

When the call is deep out of the money — i.e., when the asset price is much lower than the strike price — a one-dollar change in the asset price has little effect on the call price. When the asset price is equal to the strike price (Walker's ticket), a one-dollar change in the asset price produces roughly a half-dollar change in the call price. If the asset price rises until the call is deep in the money (where the strike price is lower than the current price), a one dollar move in the stock price results in nearly a one dollar move in the call price.

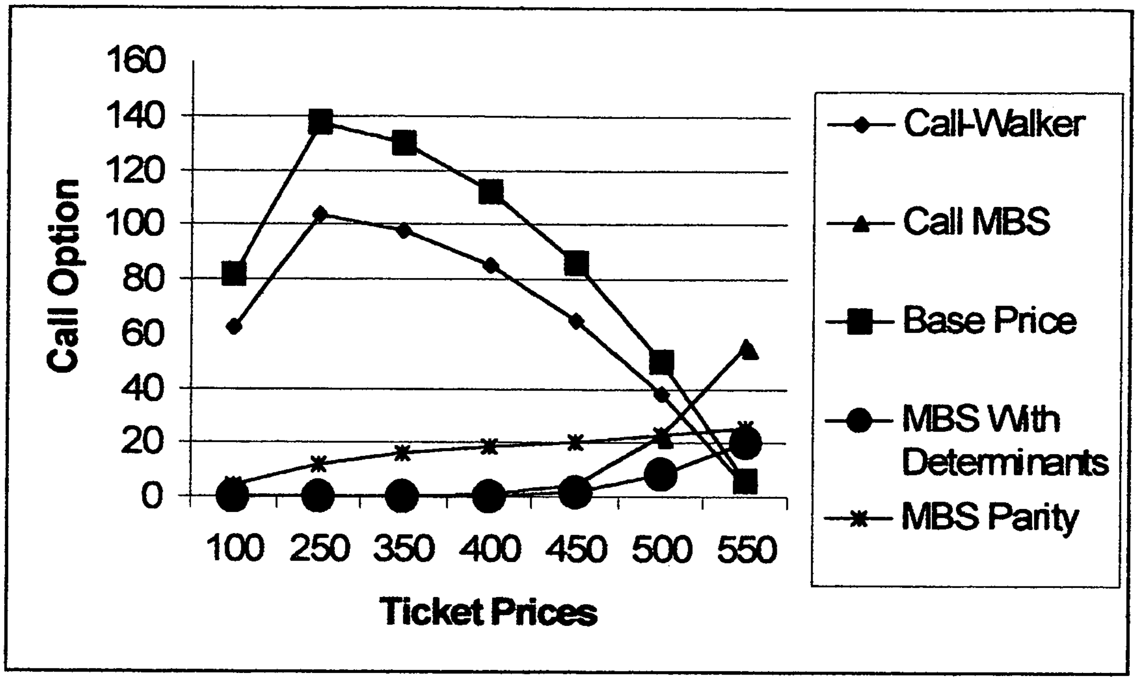
In order to analyze Walker's model and hence formula to see if it fits to what is generally known as call option behavior above, we need to understand whether are there any limitations so or any peculiarity in the airline ticketing business that may upset known principles.

Strike Price of Ticket is same as Ticket Price so customer is protecting price at the time of purchasing the call option. This means a customer is buying an option for a ticket at a certain price equal to the current price. Ticket Price can go as high as the Full Fare Price at the time of expiration. Tickets Price can go as low as zero or "Free". There is no transaction cost. Customer cannot borrow or no borrowing facility (Cost of risk free rate is not given in Walker's). By assuming the above, there is nothing extraordinary in the pricing of these option in terms of financial values except for the ceiling of Full Price. In stocks, there is no upper limit. Other determinants such as loading etc are not included here as they belong to another class. But from observation, they merely add value or reduces the 'base' value of the option and hence do not directly affect the overall principle of options. Furthermore, most of these factors are agreeable to supply and demand principles affecting the sale or attractiveness of the option rather than pricing the option. Walker did not expand on these factors nor explain how they are obtained or the ranges available. We expect these factors are observable data and hence will apply them accordingly.

To show this, we have reproduced Walker's requirements and adapted them into our modified Black Scholes Option model (the complete formula is given at the end). Because Walker has shy away from producing a complete working solutions in the patent, we have to work from whatever data that are available, in particular using the limited example in Col 7, Lines 10-35. As Black Sholes formula requires different related components, we have worked backwards statistically to conform to Walker's parameters of the elusive traveler. Our sampling data are shown at the end of this discussion.

Our result shows that Walker's model output is not consistency with known behavior of an option model. Where data is required to compare with Walker's such as Risk Free Rate which does not applied in Walker, we manage to input the value to almost zero to conform.

Table 2 (Call price as a function of Current Price)



From our observation above, an option's price should increase as the value of the underlying asset increases as show in Call MBS (Modified Black Sholes). But as can be seen after the "midpoint", Walker's call price falls following its base price. In short it means the option is less valuable when the underlying ticket price increases which is false. In practice if a passenger has purchased a call for a ticket at 500 and at expiration, the underlying ticket is 550 say, then he need only to pay 500 which makes his option more valuable at expiration. MBS with determinants means we multiply the call price by L, C, R as per Walker to confirm with peculiarities of Walker's formula. (Col 6, lines 40-65). Again we emphases not so much the exact values of these options but the general behavior of these options in real life scenarios.

Another well known property for options is that the value of a call can never be less than the value of an otherwise identical call but with a higher strike price. In Walker's case, its strike price is the same as the ticket price ie current price at the time of purchase of call. Options calls behaving in this manner can be seen in MBS Parity line which basically includes strike price and current price being equaled priced by a modified Black Sholes. In Walker's both scenario shows negative values from mid of strike price. This effect could be due to the case where Walker's uses normal distribution which has a bell shape ie one positive and one negative side. In modified Black Sholes, the model requires logarithmic returns in its standard deviation which satisfied follows the real world where prices cannot go to negative.

Another property relating to exercise prices: the difference in the value of two otherwise identical calls is never greater than the difference in their striking prices which holds true for all values for MBS Parity but as for Walker, it only holds true partially.

A final observation with true options is that the value of a call must be greater than Current Price less Strike Price at any time other than the expiration date.

Take our example of strike price 500 (ie ticket price) and the current price now is 530. The call price at 530 is using MBS is 41 which is greater than 30. Using Walker's data, the call price at 530 is 23.87 for base price. As this figure is lower than 30, the final call price will be even smaller hence inconsistent with options behavior.

Table 3a (Call Price as a function of Time to Expiration for Walker)

We use similar data as provided by Walker's example in (Col 7 line 10-35). We will show 3 different current price at 450, 500, 550 (strike price being 500) and volatility at 2 SD.

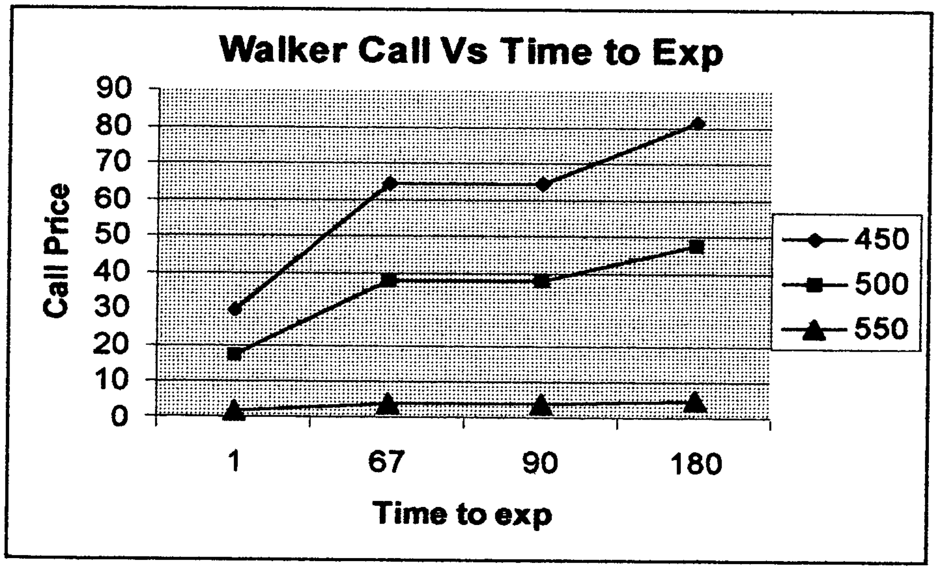
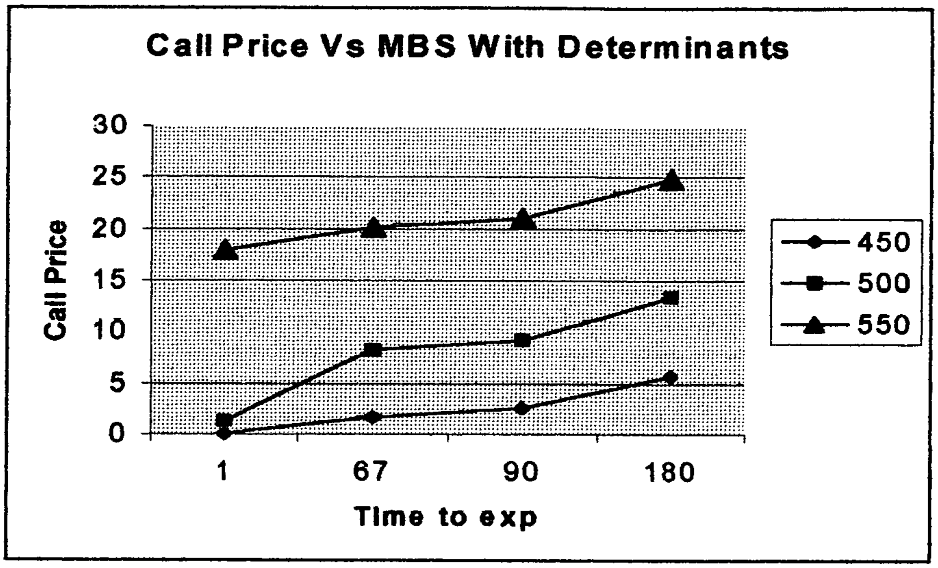


Table 3b (Call Price as a function of Time to Expiration for normal option)



As one can observed above, without looking at the actual values we can see that both charts seem to be mirroring each other where 550 is on top in table 3b and at the bottom in table 3a. We can also see that at the time of expiration in table 3a that, a 500 dollar ticket with the current price at 450 seems to have a higher call value than either situations where the current price is 500 or 550. In practice this cannot be correct since a 500 dollars ticket cannot be worth more than a current ticket at 450 at anytime.

Walker's Teaching

Walker teaches that the base price may be a fraction of the ticket price and said fraction decrease as the ticket price approaches the full fare price. (Col 6, lines 30-36) * This can be represented by the following table as an example.

Table 4

Fraction % as per Walker	Base Price= Fraction* Ticket Price as per Walker	Ticket Price (also Current Price and Strike Price)	Total Price of Ticket on Exercise (% increase over current price)	Full Ticket Price
90	9	10	19 (90%)	100
70	21	30	51 (70%)	100
50	25	50	75 (50%)	100
20	16	80	96 (20%)	100
10	9	90	99 (10%)	100

Column 1 shows the fractions as applicable as per Walker's teaching and Column 2 is the resultant base price. The problem with Walker's assumption is that the publish Full Fare is almost constant which is an industry practice, there is no "exercise price" as this is the ticket price (ie the price which the ticket is bought), this is only known by the airline not the passenger since airlines issue the price of tickets. The passenger either accepts or rejects.

This ticket price becomes the current price as well which is offered to the customer and it is this price that the customer wants to lock against higher prices. For example, the customer bought the option for a ticket priced at 10. If the price should go beyond 10 to at least 19, then the customer gains. In Walker's example, the final ticket price when exercised is often more than the ticket price at the time of purchase. In short customers must be willing to believe that the price at the time of exercise must be over say 19 as compared to 10 in time 0 (take example in row 1). This actually does not 'lock' in the cost as Walker's Patent (Col 2 lines 23-35) suggested. The final price payable 19 is more than the guaranteed 10. However, it is true that the customer do pay only 10 to purchase the ticket but the combined cost ie initial option price of 9 plus 10 would make it 19 or 90 % increase. As one can observe that the base price is actually a proxy value for Walker's option. Its main problem is that as the current price rises, this proxy value falls particularly after the midpoint, violating rule number one where both call and asset price must move in the same direction. Therefore this proxy only works for low values before the mid point . We are not sure whether this is deliberately.

In Walker, it is apparent that the price is biased towards the purchaser at a huge discount which means the seller in the long run is subsidizing the buyer. This is not the proper use of an option application. In short, Walker's formulation is unsustainable and is not price neutral. In fact, Walker's formula is more suitable to selling discounted tickets than one for hedging against rising ticket price. The base price can be interpreted as a percentage of the final price which is akin to a booking fee. For Walker's base price formula to hold as an option price, it has to hold itself to be risk neutral across the board.

In addition, for an option to work in the real world, its must have determinants ie like interest rate which measures the cost of money or funding, volatility of the underlying asset price and time premium at the very minimum. In Walker's the latter two are present and are factorized according to the fraction. Other determinants that are linked to the specific underlying asset (ie airline ticket) may be present such as C and R in Walkers (Col 6, lines 40-60).

The applicant's New Claims include a formula, which does not follow Walker's teachings and is aligned very closely to the option requirement as well as including the cost of money in its calculation.

The system in Application 09/376381 provides the opportunity for the customer to ask for the current indicative price for a type of cargo, dates of departure etc. Customer can proceed to provide the Final Price payable, this amount is reflected by the financing and

reasonable belief in the customer's own ability to actually want to secure the underlying service. At the cargo system, as soon as the base price is determined, the cargo system will decide whether this price is acceptable or not. For example, if the total cost is 100 and the customer is only willing to put up 2 leaving 98 to be paid later, it is most likely that the cargo system will reject such an offer. As evidence above, we do not face the main problem where the customer must take the ticket price and hence resulting in the exercise price equals the current price which makes the intrinsic value = zero which leads Walker to use a different method to calculate. In cargo, the current price is known but the final price payable or the exercise price in option lingo is decided by the customer and the base price is calculated based on this exercise price which in turn is determines the commercial viability of the request in cargo system.

This also shows the difference between tickets and cargo where cargo fees can be in the millions and hence it is more likely to mean that the customer will have more bargaining ability ie to negotiate the final price. Given the huge amount, interest rate or the cost of capital to the service provider has to be considered. In airline tickets, the customers must take the given price or nothing.

As shown above, we can convincingly argue that the pricing formula in Walker's patent does not exhibit option pricing properties known. So which takes us into the next question whether an option which does not exhibit realistic relationship to the underlying asset and with the real world, is it still an option ?

Another question is whether a pricing model that produce results inconsistent to behavior in practice still qualifies. In law, pricing is not the real concern here. Remember, we mentioned earlier that options are born from contracts so as long as the contract bears a value, irregardless whether this value is true, fair or in error, the contract still exist. However this goes back to patentability, if a formula bears wrong values then it is not useful although it is new.

However, half of Walker's patent hinges on this wrong formula or wrongly named formula as it could be anything (for example a booking fee) but an option as proven above. Walker also mentioned other more sophisticated formula in the specifications but does not teach them. There is no other formula in the claims.

Table 5 shows part of our data needed to draw Table 2.

Fraction	Ticket Price Current	Strike Price	Base Price	Call-Walker	Call MBS
82%	100	500	81.99982	61.991864	0
55%	250	500	137.4989	103.94915	0
37%	350	500	129.4978	97.900333	0
28%	400	500	111.9971	84.669823	0.7
19%	450	500	85.49635	64.635244	4.57
10%	500	500	49.9955	37.796598	22.77
1%	550	500	5.494555	4.1538835	55.86
0	555.55				

Table 6 shows our sample to correspond with Walker's values, which will produce a 2 SD

Price	Price Relative	Logarithmic Price Relative
200		
200	1	0
350	1.75	0.559616
300	0.857143	-0.15415
306	1.02	0.019803
305	0.996732	-0.00327
322	1.055738	0.05424
309	0.959627	-0.04121
321	1.038835	0.0381
259	0.806854	-0.21461
369	1.42471	0.353969
300	0.813008	-0.20701
281	0.936667	-0.06543
488	1.736655	0.551961
359	0.735656	-0.30699
399	1.111421	0.105639
400	1.002506	0.002503
300	0.75	-0.28768
500	1.666667	0.510826
450	0.9	-0.10536
400	0.888889	-0.11778
80.50868	SD	0.263243
338.9524	Mean	0.034657

Our Modified Black Scholes Formula is given as below;

```
s= 500 'request.form("current") Current Price
sd= 0.26 'request.form("SD") Standard Deviation
r= 0.00001 'request.form("riskfree") Risk Free Rate
t= 0.183 'request.form("time") Time in Years
x= 500 'request.form("x") Exercise Price

    a = Log(s / x)
    b = (r + 0.5 * sd ^ 2) * t
    c = sd * (t ^ 0.5)
    d1 = (a + b) / c
```

```
        d2 = d1 - sd * (t ^ 0.5)
        Call_Price = s * SNorm(d1) - x * Exp(-r    t) * SNorm(d2)   * R * C   L


Function SNorm(z)
        c1 = 2.506628
        c2 = 0.3193815
        c3 = -0.3565638
        c4 = 1.7814779
        c5 = -1.821256
        c6 = 1.3302744
        If z > 0 Or z = 0 Then
                w = 1
        Else w = -1
        End If
        y = 1 / (1 + 0.2316419 * w * z)
        SNorm = 0.5 + w * (0.5 - (Exp(-z * z / 2) / c1) * (y * (c2 + y * (c3 + y * (c4 + y *
(c5 + y * c6))))))
End Function
```

Determining a Simple Option Price.

By definition the basic mathematical option formula is shown as

Call price = intrinsic value + time premium

Intrinsic value = Max (Stock price – Exercise Price, 0)

Where call price is the option price, intrinsic value is the difference between the exercise price (the ticket price or price payable to secure the asset) and the current stock price (Ticket Price of an airline ticket) and time premium (which is the represented by factor D in Walker Col 6 lines 40-45).

To understand the workings of an option, suppose the current price of a ticket is $S =$ \$500, and at the end of a period of time, its price must be either $S^* =$ \$250 or $S^* =$ \$750. A call on the ticket is available with a strike price of $K =$ \$500, expiring at the end of the period. It is also possible to borrow and lend at a 25% rate of interest. The one piece of information left unfurnished is the current value of the call, *C*. However, if riskless profitable arbitrage is not possible, we can deduce from the given information *alone* what the value of the call *must* be!

Consider the following levered hedge:

> (1) write 3 calls at C each,
> (2) buy 2 shares at \$500 each, and
> (3) borrow \$400 at 25%, to be paid back at the end of the period.

Table 1 gives the return from this hedge for each possible level of the stock price at expiration. Regardless of the outcome, the hedge exactly breaks even on the expiration date. Therefore, to prevent profitable riskless arbitrage, its current cost must be zero; that is,

$$3C - 1000 + 400 = 0$$

The current value of the call must then be $C = \$200$.

Arbitrage Table Illustrating the Formation of a Riskless Hedge

		expiration date	
	Present date	$S^* = \$250$	$S^* = \$1000$
write 3 calls	$3C$	—	−1500
buy 2 shares	−1000	500	2000
borrow	400	−500	−500
total		—	—

If the call were not priced at \$200, a sure profit would be possible. In particular, if $C =$ \$250, the above hedge would yield a current cash inflow of \$150 and would experience no further gain or loss in the future. On the other hand, if $C = \$150$, then the same thing could be accomplished by buying 3 calls, selling short 2 shares, and lending \$400. Where interest rate is almost zero, then C is 166.7

This can be interpreted as demonstrating that *an appropriately levered position in stock will replicate the future returns of a call.* That is, if we buy shares (Ticket as in Walker's) and borrow against them in the right proportion, we can, in effect, duplicate a pure position in calls. In view of this, it should seem less surprising that all we needed to determine the *exact* value of the call was its *strike price, underlying stock price, range of movement in the underlying stock price, and the rate of interest.*